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'Tell me what you think about the geological storage of carbon dioxide': towards a fuller understanding of public perceptions of CCS

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Abstract

This paper argues that a focus on values, trust and context is vital to build a fuller understanding of public perceptions of carbon dioxide capture and storage (CCS). Empirical data from interviews conducted in the UK and Italy as part of the EU FP7-funded ECO_2 project is presented to illustrate how publics and stakeholders often evaluate the geological storage of carbon dioxide in terms of its relation to their broader world views, rather than purely in terms of the perceived techno-scientific risks of the technology.

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Keywords: carbon dioxide capture and storage; deliberation and engagement; environmental values; qualitative research; public perceptions.

1. Introduction

This paper explores some of the preliminary results of research carried out in Italy and Scotland (United Kingdom) into public perceptions of the sub-seabed geological storage of carbon dioxide (CO_2). A particular focus is placed on the wider contexts within which CO_2 storage is situated, and the

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associations publics make when they think about the geological storage of CO_2. Three broad themes emerging from preliminary data analysis are discussed: how perceptions of CO_2 storage relate to conceptions of values and fairness; association of CO_2 storage with wider environmental issues than climate change; and perceptions of CO_2 storage versus CO_2 usage.

This research has been carried out as part of the initial phase of the public perceptions study of the European Union FP7-funded ECO2 project. The aim of this phase of the work is to identify the possible range of cultural dimensions characterising the public perception of sub-seabed geological storage of CO_2. The research interviews discussed here have been designed as a first explorative step of relevant factors influencing perception and a basis for building more structured tools of investigation. To identify the categories which lead people's thinking or feeling with regard to the topic, an interview protocol has been developed, common both to the Italian and Scottish teams, that allows for free expression of the interviewee and does not pre-empt his/her possible contribution.

2. Research context

Public responses to early CCS-related projects have been mixed. At one end of the spectrum, cases of strong opposition – which have led to delays, setbacks and even outright cancellations – are well documented. The cancellation of the Barendrecht project in the Netherlands [1] has become a by-word for the lack of public consensus issues CCS could face, and the Beeskow project in Germany similarly had to be cancelled following opposition from some local groups and a loss of public trust in the developer [2]. At the other end of the spectrum, the Otway project in Australia is widely considered a success in public engagement [3], and the Ketzin project in Germany too is an example of positive public perception, due in part to early engagement, small scale and the perception of the project as a 'scientific' as opposed to 'business' endeavour [2].

Recent years have also seen a proliferation of toolkits, guidelines, best practices and meta-analyses, all of which seek to address the issue of how to engage publics on CCS and how to build public acceptance [4]. Nonetheless, underpinning all of these studies is the perhaps unchecked assumption that if one communicates the 'right' message in the 'right' way, then publics can be brought around to accept CCS. In the context of science communication more broadly, Wynne [5] wryly notes that this kind of approach replicates the much-maligned 'information deficit' approach in exactly the same breath as science communication proponents are heralding the death of such an approach!

A strong focus on communication and engagement strategy in CCS public perceptions work thus might miss the premise on which people's perceptions of the technology are actually based (although of course this will depend on the aims of the engagement strategy and on whether or not a pre-determined outcome is assumed). Nonetheless, in any case an emphasis on improving people's understanding of the geological storage of CO_2 and on communicating the risks of, say, leakage, may be of little relevance to sections of the public whose value systems are completely at odds with the use of fossil fuels or who do not trust the developer. As Mary Douglas [6] suggests, what people actually do is deliberate over notions of 'the good life' rather than the minutiae of a risk assessment. Bielicki and Stephens [7] make a very similar point in the context of CCS, arguing there is little point in communicating technical information when it is issues of value that are at stake. It might therefore be 'strategic' for research on CCS public perception to move its focus from strategies to processes in order to better understand the link between people's experiences, which are related to the context they live in, and the way they think about CCS.

We therefore suggest that the exploration of people's opinions on CO_2 storage, in a given context and time, can form a preliminary body of knowledge from which an understanding of what could be a good way for interacting with that specific public can be developed. Within this framework it is likely that a range of useful information would spontaneously emerge: different viewpoints and values, what people know and what they would like to learn about, how they evaluate the technology, and so on. There are various theoretical and research approaches that can help to explain the relationship (or lack of) between risk assessment and people's perceptions of CO_2 storage. The approach grounded in rational choice economics treats risk perceptions as manifesting individuals' implicit weighing of costs and benefits [8]; however Douglas and Wildavsky [9] argue that such an approach ignores the role of cultural ways of life in determining what states of affairs individuals see as worthy of taking risks to attain. Possibly complementary to the previous approaches is the theory grounded in social psychology and behavioural economics, which asserts that individuals' risk perceptions are pervasively shaped, and often distorted, by heuristics and biases [10].

This present study is inspired by the cultural approach [11,12], which recognizes the importance of cultural dimensions in originating social behaviour. Culture is characterised by both rational and emotional dimensions that can be traced in values and life philosophies. From this point of view, the focus on costs and benefits or on risks can be seen as a driving value. So the question will be: which are the most shared values within a given community? What is the relationship among different values? Which other aspects play a role? Is there conflict or is there cooperation between the values of different groups within the social context? The answers to these questions will be related to the specific social context being studied and will thus provide useful information to answer the requests of that particular population.

Implicit in this is that for some people, CCS may run contrary to their entire value system or world view. It may be the case that some people are unable – or unwilling – to put trust in CCS as a system. As Markusson et al [13] suggest, the most common justification for CCS requires people to buy into very big assumptions that they cannot verify for themselves. People must first accept that anthropogenic climate change is happening, then that deep and urgent cuts in anthropogenic CO_2 emissions are necessary if potentially catastrophic consequences are to be mitigated, and finally that CCS is a safe and viable way of achieving this. For people who may never accept the climate change argument, the rationale for CCS is thus at best weak. Furthermore, Markusson et al go on to argue that at each stage of this narrative, there is the possibility for people to move to a trajectory that does not lead to CCS – for example, people may favour geo-engineering to radical emissions cuts, or they may prefer renewable sources of energy.

Although the precise sequence of the decision steps hypothesized by Markusson et al could be questioned, their contribution nevertheless highlights the challenge for CCS public perceptions work to better understand the way of thinking of specific groups on the subject of CCS. In doing so, there will be at least two aspects to be considered: one related to cognitive demands, which might result in stress where there is cognitive dissonance, for example where the orthodox scientific representation comes up against local knowledge or beliefs about how the world functions; and a second related to the fact that at different stages of the process people might refer and decide based on issues such as values, trust and ethical judgements.

A key issue in this regard is the mismatch between the huge spatial and temporal scales over which climate change and the geological storage of CO_2 takes place on one hand, and the things publics notice in the physical and built environments around them on the other [14]. Indeed, in work on perceptions of

CCS and low-carbon energy with citizens in Scotland, Howell et al [15] observed hostility among publics to paying more for low-carbon energy, a reason for this being that people were only able to see rising domestic energy bills in relation to the perception that energy companies' profits were soaring at the same time. At a rather deeper level, participants in a citizens' conference in Moray expressed concern that the temporal scales on which governments and companies operate (decades) is at complete odds with the time periods associated with the storage of CO_2 (millennia) [16]. Understanding how people make sense – or not – of CCS in their daily lives is therefore an important step in building a fuller understanding of what drives public perceptions of the technology.

3. Methodology

This research seeks to attend to the above issues by developing a research framework that as far as possible allows participants to talk about CCS on their own terms. In other words, the aim is to allow people to raise the issues that they see as important, particularly concerning CO_2 storage, rather than leading them to talk about the issues that we as researchers perceive as being important.

To explain why this approach is helpful, let us return to the previous section. A communication or engagement strategy not focused on observed needs of the specific community might easily miss the grounds on which people are favorable or not to CCS. For example if a project starts from the assumption that publics are going to be concerned with, say, the risks of leakage from a storage site, and sets about developing graphics, communication materials and presentations designed to allay these fears, then people whose opposition to the project is based on economic or social justice concerns will not be engaged in the process. The discussion is already closed down to focus on risk and safety before publics have had a chance to express their opinions on their own terms.

In exactly the same way, a research methodology that starts with too many assumptions about what participants are going to want to talk about, or what they will think about CCS, runs the risk of forcing people to talk about the topics the researcher has chosen. For example, the researcher might expect that the participant is going to be concerned about leakage, so with the best of intentions will draw up an interview schedule that asks questions about media coverage, geological knowledge, analogous technologies and so on. The result of this will be that what the participant talks about is very much a reflection of the discussion framework the researcher imposes on the situation – the participant may well answer the questions related to leakage and safety, but we may never know that they are actually much more concerned by siting decisions being taken without local consultation.

As a result, the aim of this project is to open up a space where participants can talk about CCS on their own terms, where the influence of the researcher is kept in check as much as possible. This is done through a qualitative approach, one that draws on recent thinking in discursive psychology and cultural psychology. According to Potter [17], discursive psychology is a way of focusing on talk and text as social practices. What this means is that discursive psychology takes seriously the ways talk and text affect what people actually do – that is, how talk and interaction work within a person's broader life context to shape particular actions. In this perspective, sense-making is not only related to semantic negotiation between social actors but also expresses the affective dynamics of symbolization [18]. Even if one does not elect to use the language and terminology of discursive and cultural psychology, the methodological foundations it lays out in terms of foregrounding context, practice and action seem to sit well with the areas of public perceptions of CCS research that need to be explored.

As such, for this phase of the project 'free association interviews' have been deployed. In this approach, the interviewee is encouraged to talk freely about the proposed topic, with minimal input from the interviewer [19, 20]. Participants are asked to begin by simply telling the interviewer what comes to their mind when they think about the geological storage of CO_2, with the interviewer encouraging the participant to continue and giving them time to reflect if there are any pauses. In this way, the participants' perception of CCS can be elicited with as little effect from the interviewer as possible.

72 interviews were carried out with publics and stakeholders in both Italy and Scotland. The interviews were audio-recorded and transcribed, then analysed using methods of narrative content analysis. Preliminary results of this analysis are in the following sections.

4. CO_2 storage, life contexts, and fairness

We offer here some preliminary results from the free association interviews. What do people talk about when given the opportunity to speak about CO_2 storage on their own terms? A range of wide spanning issues emerge: from questions on how the technology works to its possible effects at different levels, from reflections on the reasons for adopting or not adopting the technology to the role of the public in making the choice. The interviews present a very rich and complex network of issues and arguments and what clearly appears is that perceptions of CO_2 storage relate to people's much broader values, and to their conceptions of what a fair and just way is to make energy decisions:

"The storage itself is not s-, you know, on its own is not such a major impact on my thinking, it's when the whole thing is put together [...] I think that social change is really needed drastically, the problem is we're always concerned about the economic impacts and of course the impact that that will have on politicians' jobs or whatever, erm, but there needs to be a massive social, social shift in the consciousness". (Stephen[1], male, UK)

Stephen's cautious view of CCS is not informed by the technological aspects of CCS, but rather by his belief that fundamental social and political change is needed to combat the problems of climate change rather than a technological 'fix'. Indeed, a number of interviewees place the consideration of CO_2 storage within the framework of a global appraisal of our society's organization and lifestyle. They make observations on how the problem of CO_2 is created in our society and relate the choice of the implementation of CO_2 storage to the need to reconsider common everyday activities:

"It seems absurd to me that we import parsley from Chile, it comes in small packets, it's not 10 km, sure it's light, but it's not a paediatric dose of parsley. The CO_2 that you find in these goods, that come in packets, is an exceeding quantity if you consider the plastic, the production of parsley, the transport, myself while I go buying it and bring it back home, it's an exaggerated quantity, for two "minchia" leaves of parsley, it would really be much easier to intervene on this kind of mechanism, rather than making a gigantic hole". (Rosario, male, Italy)

The need to face the problem of climate change and make decisions nevertheless raises other concerns that again relate to much wider themes surrounding CO_2 storage. At a technological level, it is not clear for some how the public may find the information they need to make an informed decision:

[1] All interviewee names given in this paper are pseudonyms.

"We will never get to an official version of facts, I mean somebody saying: things are like this, to avoid, given global warming of the planet, this is one of the ways that you can get, through this input of this CO_2 in the underground, how do we choose the soil, what analysis is made, what is the effect down there, how is then this carbon dioxide transformed. In my opinion there won't quite be a disinterested version of the situation". (Carmela, female, Italy)

Another key issue in this regard is perceptions of fairness and involvement in discussions over energy developments. Some people explained that as they learned more about energy proposals (which, even if the project in question was only hypothetical, were inevitably very detailed in terms of infrastructural and technical detail), their feelings turned from curiosity or enthusiasm to ones of despair or frustration, in that decisions had been taken without consideration for the local community:

"this is an area that gets abused and used rather than it coming from the community. So all the big wind farms that are going in, yeah there's tokenism to the local community but actually there's no, no great benefit to the local community, whereas if our council had said yep you can do what some other places have done, and we'll have, we'll give planning permission to these wind farm, but the local community has to have cheap, erm, electricity first, and then it can get exported, fine, come on in. At the moment that's not happened". (Gail, female, UK)

In this case, the participant was discussing the geological storage of CO_2 with allusion to recent wind energy developments in the same area of the country. When potential technologies for the mitigation of climate change are presented to the public, the detail of the plans can seem give the impression that all the big decisions regarding the nature of the proposals have already been made without any local public consultation. These feelings become all the more significant when compared with the view of Scott, an environmental assessor for a major fossil fuel company, on the deployment of CCS:

"there is an end goal, particularly in Scotland and the western world of trying to move to renewables, but that's not going to happen any time soon, so to reduce the potential effects of global warming […] in the relatively short term CCS is the only opportunity because we have the infrastructure and capability, technology and some of the knowledge to be able to do that". (Scott, male, UK)

When one contrasts the hopes and expectations of people like Gail with the perhaps more 'realistic' perspective offered by Scott, it is clear to see how publics can come to feel they have been excluded from decision making processes. This raises interesting questions about the role of the humanities in CCS (and energy more broadly) discussions, in that public engagement work is almost exclusively done 'after' all of the technological decisions have been taken. It may also be the case, however, that clearer management of people's expectations is required at the outset of the deliberation process, so that publics are able to join the discussion fully aware of what effect their contributions can have.

5. More than climate change? CO_2 storage, humans and the environment

A second strand emerging from the data concerns public perception of CO_2 storage in a much bigger environmental context. Only rarely did participants directly link CO_2 storage to climate change mitigation. Rather, what seemed to emerge was a much wider discourse centred on whether behaviours and actions were 'good' or 'bad' for the environment. This discourse went along a number of different

paths, from specific to global concern. Pollution appears to be an inclusive category that relates CO_2 storage to what we are doing to the environment, as this environmental consultant argues:

"If I pollute one cubic metre of soil, ok? Maybe to purify one cubic metre you need to. But if with that cubic metre that I have polluted then I affect, it makes a small bird sick, that afterwards is eaten by a fox, and she too gets sick, she suffers: that is in the end it seems a limited damage but, studying it in time, the damage grows, is exponential, becomes bigger all the time". (Giovanni, male, Italy)

Different kinds of pollution are considered. For example, a marine biologist working for a non-governmental organization admitted he knew few specifics about CO_2 storage but expressed concern about its potential effects on non-humans:

"most people will not understand, quite reasonably, that noise travels much better in water and that these animals are very vulnerable to extra input of noise, so a particular concern of recent years has been seismic surveys conducted by the oil and gas industry [...] there may therefore be a concern that carbon capture may require the same kind of surveys, which would be potentially of concern to us because they're likely to impact the animals". (Malcolm, male, UK)

It is interesting to note that this dialogue makes very few, if any, references to anthropogenic climate change as such, and much more to the pressures that human activity in general – fossil fuel extraction, renewable energy construction, trawling, sea freight – places on the marine environment. For Malcolm, CCS is just one thing among many that is going on in the marine environment. This is not to say that publics and stakeholders will not be concerned about offshore CO_2 storage because they have lots of other things to be concerned about, just that they may see it as one of many factors driving change in the environment. This change presents disturbing features, something that one day we will inevitably be confronted with as this insurer suggests:

"I have immediately associated this kind of operation to something negative for the environment, because the first thing coming to my mind is the forcing of nature, namely taking CO_2 from the atmosphere following pollution. Society that keeps evolving more and more and thus the CO_2 content in the atmosphere always increases, from tenths of years to tenths of years, then what does man do? He takes his waste and puts it back underground. At first, what has come to my mind is the lady who sweeps around home and hides the dirt under the carpet no? May be the room is clean but there is something rotten under the carpet". (Massimiliano, male, Italy)

Noticeable in both of the extracts above is the lack of direct correlation to anthropogenic climate change. Whilst both interviewees undoubtedly see the geological storage of CO_2 as having potentially negative effects on the environment, they talk about this in much broader terms: the first interviewee by citing potential distress to non-humans, the second by alluding to storing up trouble for later. The implication of this may be that public perceptions of CO_2 storage are influenced not just by perceptions of climate change, but by much more general conceptions of how humans relate to the natural world around them.

6. CCS as an opportunity

For others, CCS and an excess of CO_2 can have a completely different meaning, one very much removed from climate change or environmental damage. Consider economist Andrew's view:

"we have found the cases where the CO_2 EOR is actually viable, but erm a key condition i- is that, erm, the transfer price of the CO_2 to the storer is well below the carbon price floor value. At the carbon price floor value, it's, it's erm, it's going to, not going to be viable for the EOR storer, um, to invest. So in a nutshell tha- that's what we found". (Andrew, male, UK)

For Andrew, carbon dioxide is not a problem but an opportunity! In the same way, Giovanni in his interview illustrates the many ways CO_2 can be used, from coffee decaffeination to algae production and highlights how many substances that we consider waste could in fact be seen in a different way:

"We now live in a world where, for good or evil there is a lot, in a world where there is, I mean we throw away too many useless things, I mean too many useful things". (Giovanni, male, Italy)

The relationship between humans, carbon and the natural environment can thus be construed in a number of ways. This also raises ethical questions that have thus far received little attention in the humanities' and social sciences' consideration of CCS, and that warrant further enquiry in the future. Indeed, as Malcolm goes on to say later in his discussion, the voices of those humans concerned with the well-being of nature have thus far been very faint in discussions over energy futures. More broadly, there are also unanswered questions over the extent to which we as humans have the right to interfere with non-sentient natural structures. Whilst these issues may not necessarily be greatly different to claims surrounding human exploitation of gas, oil and other minerals, there is potential for discussion over CCS to bring these issues to the fore and stimulate a deeper discussion of the consequences of humans' actions on nature. In this way, the idea of capturing and storing carbon dioxide could not only be an opportunity for technological innovation on CO_2 use, but also a chance to trigger much deeper discussions on humans' environmental impacts. For instance, linking back to the point made above about the psychological effects of CO_2 storage, could CCS come to be viewed as a failure of society's decision makers to find valid solutions and make the right decisions on issues that are crucial for the sustainability of our life system? Could it even also be viewed as a failure of individuals themselves to make the behavioural and lifestyle changes necessary for transition to a low-carbon society? As a policy researcher described the geological storage of CO_2:

"It's a sticking plaster, nothing more than that. It buys us a little bit of time, but we have to move away from this whole carbon economy. The basis of our whole way of life as it is today is completely unsustainable, and if we can't move away from that then we will have failed". (Brendan, male, UK)

7. Discussion and conclusions

In summary, preliminary results from the explorative interviews performed in Italy and the UK show three possible areas for CO_2 storage perception: 1) CO_2 storage appears to elicit global considerations on lifestyles and decision making processes; 2) CO_2 storage is considered in the light of humanity's relationship with nature and the environment; 3) CO_2 storage is placed in a value chain.

As far as global considerations on lifestyles and decision-making processes goes, it seems that many of the publics interviewed consider the storage of CO_2 in terms of the ways in which contemporary lifestyles are structured. That is, for many the need to mitigate CO_2 emissions is seen as arising from the unsustainable ways in which we live, and that a more effective solution may be to reconsider the social fabric of our lives. Further, some also question the ability of publics to get involved in decisions over

energy and environmental issues, and also the extent to which society can take actions necessary to mitigate climate change. As for the relationship between humans and nature, it is interesting to note that CO_2 storage does not in many cases prompt automatic correlation with anthropogenic climate change – rather, the goodness or badness of storage is discussed in much broader terms of the impacts humans can have on the natural environment. Finally, the notion of a value chain suggests that CO_2 is not necessarily perceived as something negative or troublesome, for some people it could represent an opportunity.

These findings raise several pertinent points to consider as this research on public perception of CCS goes forwards. One issue is the problem of talking about individual low-carbon energy options when there is no collective sanctioned forum for considering all energy options. In other words, where are members of the public supposed to go to if they want to talk about energy policy? Designing public engagement on CCS is one thing, but there is no mandated opportunity for having a discussion on what kinds of energy futures 'we' as a whole society want, what the relative role is of demand reduction, individual low-carbon (or not so low carbon) technologies, how we tackle domestic heat, transport and so on. Even if such fora can be established, a separate challenge is to get the key insights from such processes into public policy making. The representative style of governance allows influence from elected members, lobby groups, entrenched industry partners and even NGOs, but there is no clear role for the lay public.

This also presents a methodological challenge. The development of techniques and methods that allow people to speak freely about their thoughts on CO_2 storage can provide a valid and systematic understanding of public perception on the topic, yet at the same time the way people participate in the research will be linked to their idea or expectation of what the researcher may be able to do with the data. For instance, if a researcher is representing a European Union-funded project, then the interviewee may form ideas about the kind of people that are going to see the research findings and the level of influence this could have on their thinking. Rather than viewing this as a problem of managing public expectation, however, it perhaps provides a timely opportunity for thorough critical reflection on the role of researchers in facilitating dialogue over energy futures - a role which, if managed carefully, has the potential to begin to facilitate public involvement in previously opaque and inaccessible domains.

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